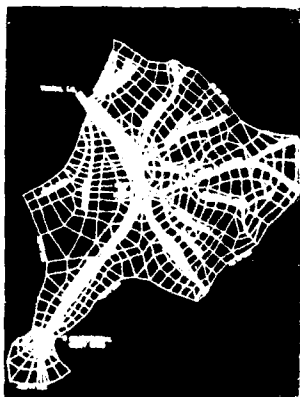




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MISCELLANEOUS PAPER HL 87-7

A NUMERICAL MODEL ANALYSIS OF MISSISSIPPI RIVER PASSES NAVIGATION CHANNEL IMPROVEMENTS

Report 3

BANK BREACHING WITHOUT SUPPLEMENT 2

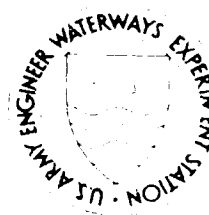
by

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Preface

The study described herein was conducted during 1985-1987 for the US Army Engineer District, New Orleans, by personnel of the Hydraulics Laboratory (HL) of the US Army Engineer Waterways Experiment Station (WES) under the general supervision of Messrs. H. B. Simmons and F. A. Herrmann, Jr., former and present Chiefs, respectively, of HL, and R. A. Sager and W. H. McAnally, former and present Chiefs, Estuaries Division (ED). The study was performed and this report written by Messrs. D. R. Richards and M. J. Trawle, ED. It is the third in a series of reports listed below.

COL Dwayne G. Lee, EN, is the Commander and Director of WES.
Dr. Robert W. Whalin is the Technical Director.

Reports in this series:

- Report 1: 55-Foot Channel Tests
- Report 2: 45-Foot Channel Tests and Flow Diversion Schemes
- Report 3: Bank Breaching Without Supplement 2
- Report 4: Two-Dimensional Hydrodynamic and Sediment Transport Verification
- Report 5: Three-Dimensional Numerical Model Results

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Conversion Factors, Non-SI to SI (Metric)
Units of Measurement

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
cubic feet	0.02831685	cubic metres
cubic yards	0.7645549	cubic metres
feet	0.3048	metres
miles (US statute)	1.609347	kilometres

A NUMERICAL MODEL ANALYSIS OF MISSISSIPPI RIVER PASSES
NAVIGATION CHANNEL IMPROVEMENTS

BANK BREACHING WITHOUT SUPPLEMENT 2

Purpose

1. The purpose of this report is to provide in summary form the results from the numerical model studies to date. It is the third in a series of reports written for this purpose. All of the project conditions discussed herein involve analyses using the two-dimensional (2D) hydrodynamic and sediment transport models. They were not requested in the original scope of work, but it was agreed that these 2D analyses would be performed while code modifications were being made to the three-dimensional hydrodynamic model.

2. Specifically, this report presents test results for the following conditions:

- a. Future condition without Supplement 2 including bank breaching (640,000-cfs flow).
- b. Future condition without Supplement 2 including bank breaching (900,000-cfs flow).
- c. Future condition without Supplement 2 including bank breaching (1,300,000-cfs flow).

For each of these tests, the bank breaching occurred at approximately mile 3 and mile 9 BHP. In the following discussion, results from these tests are compared to the existing condition (BASE) and future condition without Supplement 2 (no bank breaching) tests (BANK) which had been conducted previously.

Hydrodynamic Results

3. The hydrodynamic results discussed herein compare the future-condition-without-Supplement 2 (no bank breaching) tests to the future-condition-without-Supplement 2 (with bank breaching) tests. This report summarizes the condition in which no improvement in the overbanks is complicated by bank breaching in two likely spots. Baptiste Collette Bayou among others provides the historical precedent that warrants such consideration. The choice of breaks at miles 3 and 9 was made by the New Orleans District (LMN) due to the advanced state of disrepair currently at these locations.

4. Hydrodynamic data are summarized in Table 1 for existing condition (BASE), future condition without Supplement 2 and no bank breaching (BANK), and the BANK condition with the addition of two breaks in the Southwest Pass overbanks (BRAK). Results were provided for each of the desired discharges at Venice: 640,000, 900,000, and 1,300,000 cfs. The results indicate consistency with previously modeled and reported conditions.

5. The BANK and BRAK conditions had a marked impact on the hydrodynamic results. Flow distributions at Head of Passes were shifted heavily toward Southwest Pass with these conditions, which is explained by the decrease in frictional resistance when the overbanks are deteriorated and/or broken out. With these conditions, an expected loss of water-surface slope and lower Southwest Pass velocities are experienced. The increase of flow diversion to Southwest Pass along with the decrease in velocities will result in a significant increase in sediment load to Southwest Pass without an increase in sediment carrying capacity. This result will be noticed for each of the design flows.

Sedimentation Results

6. Because of the almost continuous dredging activity that typically occurs along Southwest Pass during periods of high river stages, it is difficult to determine representative shoaling rates for high-stage conditions. The approach used in this study to establish high-stage shoaling rates was to evaluate relatively short periods of time in 1982, 1983, and 1984. During these selected time periods, the river stage was high and dredging activity was minimal.

7. Model verification was based on comparison of observed prototype shoaling rates along Southwest Pass during five relative short periods of time (2 weeks to 1 month) in which the Carrollton stage ranged between 10 and 16 ft and dredging activity along Southwest Pass was nil. Using hydrographic surveys, prototype shoaling rates were calculated during December 1982, January 1983 (Mile 10-20 BHP only), December 1983 (Mile 6-20 BHP only), April 1984 (Mile 0-6 BHP only), and November 1984. The model was adjusted until shoaling along Southwest Pass for the range of flows tested fell within the band provided by the observed shoaling rates. Overall the 2D sediment transport model behavior agreed well with the observed shoaling patterns. Results from the

verification effort are not included in this report but will be discussed in detail in a separate report.

8. The numerical sediment transport simulations were made using steady-state currents with a median grain size of 0.15 mm. Depth-averaged suspended sediment concentrations at the Head of Passes were approximately 150 ppm for the 640,000-cfs tests, 300 ppm for the 900,000-cfs tests, and 500 ppm for the 1,300,000-cfs tests.

9. Sediment transport predictions for the previous future condition without Supplement 2 (no bank breaching) compared to the existing condition tests are shown in Table 2. Sedimentation predictions for the future condition without Supplement 2 (with bank breaching) compared to the existing condition tests are given in Table 3. The increases in shoaling rates are expressed in percentages of those observed in the existing (BASE) condition of 640,000, 900,000, and 1,300,000 cfs at Venice. As can be seen, the future condition without Supplement 2 and no bank breaching (BANK) caused increases of 8, 17, and 30 percent, respectively, over the BASE condition. The future condition without Supplement 2 and with bank breaking (BRAK) caused even greater increases of 14, 31, and 56 percent, respectively, over the BASE conditions.

Summary

10. The model results discussed in this report demonstrate the detrimental effects of further bank deterioration on channel shoaling along Southwest Pass. As the overbank deterioration increases, corresponding increases in maintenance dredging requirements should be expected.

Table 1
Flow Distribution, Stages, and Velocities for
BASE, BANK, and BRAK Conditions

% of Venice Flow	640,000 cfs*			900,000 cfs*			1,300,000 cfs*		
	BASE	BANK	BRAK	BASE	BANK	BRAK	BASE	BANK	BRAK
B. Collette	3	2	2	3	2	2	3	2	2
Grand/Tiger	4	3	3	4	3	3	4	3	3
Cubits Gap	6	5	5	6	5	5	6	5	5
SWP (& DS)**	32(15)	36(12)	41(7)	30(14)	33(12)	38(8)	29(13)	30(11)	34(8)
SP (& DS)**	17(2)	16(2)	14(1)	17(2)	16(1)	15(1)	17(2)	17(1)	16(1)
PAL	24	21	19	22	20	18	21	19	17
Channel†	86	83	84	82	79	81	80	76	77
Overbank†	14	17	16	18	21	19	20	24	23
Stage, ft NGVD††									
Venice	2.7	2.4	2.3	3.7	3.4	3.3	5.0	4.6	4.5
Cubits Gap	2.2	1.9	1.8	3.0	2.8	2.6	4.1	3.8	3.6
Head of Passes	2.0	1.7	1.5	2.7	2.4	2.2	3.6	3.3	3.0
Upper Southwest Pass	0.6	0.4	0.3	0.8	0.6	0.4	1.1	0.9	0.6
SWP Jetties	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Velocities, fps††									
Venice	4.5	4.6	4.6	6.4	6.4	6.4	8.7	8.7	8.7
Cubits Gap	3.0	3.0	3.1	4.0	4.0	4.1	5.2	5.1	5.3
Head of Passes	3.0	3.1	3.3	4.0	4.1	4.4	5.3	5.4	5.7
Upper Southwest Pass	1.5	1.4	1.0	2.1	2.0	1.5	2.9	2.8	2.2
SWP Jetties	1.0	0.7	0.4	1.4	1.1	0.7	1.9	1.5	1.1

* Discharge at Venice, LA.

** Downstream at entrance.

† Above Head of Passes.

†† Typical midstream.

Table 2

Change in Shoaling Along Southwest Pass (Mile 0-20 BHP) Resulting
from Future Condition Without Supplement 2 (BANK)

<u>Discharge</u> <u>(1,000 cfs)</u>	<u>BASE</u> <u>Shoaling</u> <u>(10⁶ cu yd/month)</u>	<u>BANK</u> <u>Shoaling</u> <u>(10⁶ cu yd/month)</u>	<u>Increase</u> <u>(percent)</u>
640	0.92	0.99	+ 8
900	1.36	1.59	+17
1,300	2.55	3.32	+30

Table 3

Change in Shoaling Along Southwest Pass (Mile 0-20 BHP) Resulting
from Future Conditions Without Supplement 2 and
with Bank Breaching (BRAK)

<u>Discharge</u> <u>(1,000 cfs)</u>	<u>BASE</u> <u>Shoaling</u> <u>(10⁶ cu yd/month)</u>	<u>BRAK</u> <u>Shoaling</u> <u>(10⁶ cu yd/month)</u>	<u>Increase</u> <u>(percent)</u>
640	0.92	1.05	+14
900	1.36	1.78	+31
1,300	2.55	3.98	+56